

WHAT IS CLAIMED IS:

1. A semiconductor memory device comprising:
  - a semiconductor substrate;
  - an element region provided on the semiconductor
  - 5 substrate;
  - an element-isolating region provided around the element region and on the semiconductor substrate;
  - a trench provided in the semiconductor substrate, the trench contacting the element region;
  - 10 a capacitor having a first electrode provided in the semiconductor substrate and a second electrode provided in the trench;
  - a first insulating film provided on a side surface of the trench and on the capacitor;
  - 15 a first conductive layer provided on the first insulating film and the second electrode so as to bury the trench;
  - a second insulating film provided on a side surface of the trench and on the first insulating film,
  - 20 and provided on both side surfaces of the element region;
  - a gate electrode provided on the element region through a gate insulating film;
  - a source region and a drain region provided in the element region on both sides of the gate electrode; and
  - 25 a contact layer provided on the first conductive layer and the element region so as to connect the first

conductive layer with the source region or the drain region.

2. The semiconductor memory device according to claim 1, the second insulating film formed of an oxide film.

3. The semiconductor memory device according to claim 2, the oxide film being a thermal oxide film.

4. The semiconductor memory device according to claim 1, further comprising side wall insulating films provided on side walls of the gate electrode, the side wall insulating films formed of an insulation material different from that of the second insulating film.

5. The semiconductor memory device according to claim 4, the side wall insulating films being formed of a nitride film.

6. The semiconductor memory device according to claim 1, wherein an upper surface of a part of the element-isolating region contacting the element region is lower than an upper surface of the element region.

7. The semiconductor memory device according to claim 1, wherein an upper surface of the first conductive layer is higher than an upper surface of the first insulating film.

8. The semiconductor memory device according to claim 1, wherein the second insulating film is in contact with the source region or the drain region.

9. The semiconductor memory device according to

claim 1, wherein the semiconductor substrate is formed of silicon.

10. The semiconductor memory device according to claim 1, wherein the first conductive layer and the contact layer are formed of silicon doped with an impurity of a first conductivity type.

11. The semiconductor memory device according to claim 1, the capacitor comprising: a first diffusion layer for the first electrode, provided in the semiconductor substrate so as to be in contact with an inner surface of the trench; a capacitor insulating film provided on the diffusion layer exposed as the inner surface of the trench; and a conductive layer for the second electrode, provided on the capacitor insulating film so as to bury a lower portion of the trench.

12. A method of manufacturing a semiconductor memory device, comprising:

forming a trench in a semiconductor substrate;  
forming a capacitor having a first electrode provided in the semiconductor substrate and a second electrode provided in the trench;

forming a first insulating film on a side surface of the trench and on the capacitor;

forming a first conductive layer on a side surface of the first insulating film and on the second electrode so as to bury the trench;

forming an element-isolating region on the semiconductor substrate and around an element region in which a transistor is to be formed;

5 forming a gate electrode on the element region through a gate insulating film;

forming a source region and a drain region in the element region on both sides of the gate electrode;

etching an insulating film formed on the first conductive layer;

10 forming a second insulating film on a side surface of the trench and on the first insulating film, and on both side surfaces of the element region; and

forming a contact layer on the first conductive layer and the element region so as to connect the first  
15 conductive layer with the source region or the drain region.

13. The method according to claim 12, wherein the second insulating film is formed by thermal oxidation.

14. The method according to claim 12, further  
20 comprising, after the forming the gate electrode, forming side wall insulating films formed of an insulation material different from that of the second insulating film on side walls of the gate electrode.

15. The method according to claim 12, wherein the  
25 semiconductor substrate is formed of silicon.

16. A method of manufacturing a semiconductor memory device, comprising:

forming a trench in a semiconductor substrate;  
forming a capacitor having a first electrode  
provided in the semiconductor substrate and a second  
electrode provided in the trench;

5           forming a first insulating film on a side surface  
of the trench and on the capacitor;

          forming a first conductive layer on the first  
insulating film and the second electrode so as to bury  
the trench;

10           forming an element-isolating region on the  
semiconductor substrate and around an element region  
in which a transistor is to be formed;

          forming a gate electrode on the element region  
through a gate insulating film;

15           forming a source region and a drain region in the  
element region on both sides of the gate electrode;

          forming an insulating layer on the element region  
and the element-isolating region;

20           etching the insulating layer formed on a region in  
which a contact layer connecting the first conductive  
layer with the source region or the drain region is to  
be formed;

          etching an insulating film formed on the first  
conductive layer;

25           forming a second insulating film on a side surface  
of the trench and on the first insulating film, and on  
both side surfaces of the element region; and

forming the contact layer on the first conductive layer and the element region.

17. The method according to claim 16, wherein the second insulating film is formed by thermal oxidation.

5        18. The method according to claim 16, further comprising, after the forming the gate electrode, forming side wall insulating films formed of an insulation material different from that of the second insulating film on side walls of the gate electrode.

10        19. The method according to claim 16, further comprising, after the forming the source region and the drain region, forming a protective film on the element region and the element-isolating region.

15        20. The method according to claim 16, the semiconductor substrate is formed of silicon.